



**TABLE A**  
**ROCK CORE DESCRIPTION**

LOCATION		CORE RECOVERY				CORE DESCRIPTION	
STATION	BH	RC	DEPTH (m)	REC (%)	RQD (%)	DEPTH (m)	DESCRIPTION
Ungulate Guard at Sta. 9+710 Hwy 637 Service Road	1	9	7.2 – 7.9	83	83	7.2 – 9.3	PYROXENITE: Dark green to black, medium crystalline in light green matrix, medium to high strength, slightly weathered to unweathered, close to moderate spaced flat to dipping cross joints, rough to smooth planar, generally tight to slightly altered with oxidation stains and/or black residue on partings, good quality.  Becoming dark grey to black, fine crystalline, medium strength, slightly weathered, very close to close spaced dipping cross joints, rough planar to slickensided planar, generally tight, locally oxidized, with some vertical joints, with black residue on partings, poor quality.
		10	7.9 – 9.3	96	83		
		11	9.3 – 10.5	93	44	9.3 – 10.5	
Ungulate Guard at Sta. 10+033.5 Hwy 637 Service Road	1	5	2.3 – 3.5	90	90	2.3 – 5.4	GRANITIC GNEISS: Light grey and pink, very slight banding, fine to medium crystalline, high strength, slightly weathered to unweathered, moderate to wide spaced flat to dipping cross joints, rough planar, generally tight to slightly altered with oxidation stains on partings, excellent quality.
		6	3.5 – 3.9	94	94		
		7	3.9 – 4.8	99	96		
		8	4.8 – 5.4	100	100		
Ungulate Guard at Sta. 10+033.5 Hwy 637 Service Road	3	4	1.9 – 3.4	100	100	1.9 – 4.9	GRANITIC GNEISS: Light grey and pink, slight dipping bands, fine to medium crystalline, high strength, slightly weathered to unweathered, close to wide spaced flat to dipping cross joints, rough planar, generally tight to slightly altered with silt on some partings, excellent quality.
		5	3.4 – 4.9	100	92		

Originated: JFW  
 Compiled: FP  
 Checked: MN / CN



**TABLE A**  
**ROCK CORE DESCRIPTION**

LOCATION		CORE RECOVERY				CORE DESCRIPTION	
STATION	BH	RC	DEPTH (m)	REC (%)	RQD (%)	DEPTH (m)	DESCRIPTION
Ungulate Guard at Sta. 10+033.5 Hwy 637 Service Road	4	4	1.8 – 2.9	98	73	1.8 – 4.8	GRANITIC GNEISS: Light grey and pink with occasional dark grey layers, fine to medium crystalline, high strength, slightly weathered to unweathered, close to wide spaced flat to dipping cross joints, rough planar, tight to slightly altered with yellow coloured oxidation stains on partings, good to excellent quality.
		5	2.9 – 4.5	100	95		
		6	4.5 – 4.8	100	100		
Ungulate Guard at Sta. 10+033.5 Hwy 637 Service Road	6	3	1.4 – 2.0	94	92	1.4 – 4.6	GRANITIC GNEISS: Light grey and pink dipping bands, fine to medium crystalline, high strength, generally unweathered with 50 mm thick layer of highly weathered material at 3.1 m depth, close to wide spaced dipping cross joints, rough planar, generally tight (locally altered, oxidized yellow to rust colour, friable, sandy), excellent quality.
		4	2.0 – 3.5	100	93		
		5	3.5 – 4.6	100	100		

RQD = Rock Quality Designation

Originated: JFW  
 Compiled: FP  
 Checked: MN / CN

## EXPLANATION OF TERMS USED IN REPORT

**N VALUE:** THE STANDARD PENETRATION TEST (SPT) N VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51mm O.D. SPLIT BARREL SAMPLER TO PENETRATE 0.3m INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5kg, FALLING FREELY A DISTANCE OF 0.76m. FOR PENETRATIONS OF LESS THAN 0.3m N VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. AVERAGE N VALUE IS DENOTED THUS  $\bar{N}$ .

**DYNAMIC CONE PENETRATION TEST:** CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51mm O.D. 60° CONE ANGLE) DRIVEN BY 475 J IMPACT ENERGY ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 0.3m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

**CONSISTENCY:** COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH ( $c_u$ ) AS FOLLOWS:

$c_u$ (kPa)	0 - 12	12 - 25	25 - 50	50 - 100	100 - 200	> 200
	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD

**DENSENESS:** COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF DENSENESS AS INDICATED BY SPT N VALUES AS FOLLOWS:

N (BLOWS/0.3m)	0 - 5	5 - 10	10 - 30	30 - 50	> 50
	VERY LOOSE	LOOSE	COMPACT	DENSE	VERY DENSE

ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND / OR STRENGTH.

**RECOVERY:** SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH OF THE CORING RUN.

**MODIFIED RECOVERY:** SUM OF THOSE INTACT CORE PIECES, 100mm+ IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (R Q D), FOR MODIFIED RECOVERY, IS:

R Q D (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
	VERY POOR	POOR	FAIR	GOOD	EXCELLENT

**JOINTING AND BEDDING:**

SPACING	50mm	50 - 300mm	0.3m - 1m	1m - 3m	> 3m
JOINTING	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

## ABBREVIATIONS AND SYMBOLS

### FIELD SAMPLING

S S	SPLIT SPOON	T P	THINWALL PISTON
W S	WASH SAMPLE	O S	OSTERBERG SAMPLE
S T	SLOTTED TUBE SAMPLE	R C	ROCK CORE
B S	BLOCK SAMPLE	P H	T W ADVANCED HYDRAULICALLY
C S	CHUNK SAMPLE	P M	T W ADVANCED MANUALLY
T W	THINWALL OPEN	F S	FOIL SAMPLE
F V	FIELD VANE		

### STRESS AND STRAIN

$u_w$	kPa	PORE WATER PRESSURE
$u$	1	PORE PRESSURE RATIO
$\sigma$	kPa	TOTAL NORMAL STRESS
$\sigma'$	kPa	EFFECTIVE NORMAL STRESS
$\tau$	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
$\epsilon$	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
$\mu$	1	COEFFICIENT OF FRICTION

### MECHANICAL PROPERTIES OF SOIL

$m_v$	$kPa^{-1}$	COEFFICIENT OF VOLUME CHANGE
$C_c$	1	COMPRESSION INDEX
$C_s$	1	SWELLING INDEX
$C_\alpha$	1	RATE OF SECONDARY CONSOLIDATION
$c_v$	$m^2/s$	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
$T_v$	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
$\sigma'_{vo}$	kPa	EFFECTIVE OVERBURDEN PRESSURE
$\sigma'_p$	kPa	PRECONSOLIDATION PRESSURE
$\tau_f$	kPa	SHEAR STRENGTH
$c'$	kPa	EFFECTIVE COHESION INTERCEPT
$\phi'$	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
$c_u$	kPa	APPARENT COHESION INTERCEPT
$\phi_u$	-°	APPARENT ANGLE OF INTERNAL FRICTION
$\tau_R$	kPa	RESIDUAL SHEAR STRENGTH
$\tau_r$	kPa	REMOULDED SHEAR STRENGTH
$S_t$	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

### PHYSICAL PROPERTIES OF SOIL

$\rho_s$	$kg/m^3$	DENSITY OF SOLID PARTICLES	n	1, %	POROSITY	$e_{max}$	1, %	VOID RATIO IN LOOSEST STATE
$\gamma_s$	$kN/m^3$	UNIT WEIGHT OF SOLID PARTICLES	w	1, %	WATER CONTENT	$e_{min}$	1, %	VOID RATIO IN DENSEST STATE
$\rho_w$	$kg/m^3$	DENSITY OF WATER	$S_r$	%	DEGREE OF SATURATION	$I_D$	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
$\gamma_w$	$kN/m^3$	UNIT WEIGHT OF WATER	$w_L$	%	LIQUID LIMIT	D	mm	GRAIN DIAMETER
$\rho$	$kg/m^3$	DENSITY OF SOIL	$w_p$	%	PLASTIC LIMIT	$D_n$	mm	n PERCENT - DIAMETER
$\gamma$	$kN/m^3$	UNIT WEIGHT OF SOIL	$w_s$	%	SHRINKAGE LIMIT	$C_u$	1	UNIFORMITY COEFFICIENT
$\rho_d$	$kg/m^3$	DENSITY OF DRY SOIL	$I_p$	%	PLASTICITY INDEX = $w_L - w_p$	h	m	HYDRAULIC HEAD OR POTENTIAL
$\gamma_d$	$kN/m^3$	UNIT WEIGHT OF DRY SOIL	$I_L$	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	q	$m^3/s$	RATE OF DISCHARGE
$\rho_{sat}$	$kg/m^3$	DENSITY OF SATURATED SOIL	$I_C$	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$	v	m/s	DISCHARGE VELOCITY
$\gamma_{sat}$	$kN/m^3$	UNIT WEIGHT OF SATURATED SOIL	DTPL		DRIER THAN PLASTIC LIMIT	i	1	HYDRAULIC GRADIENT
$\rho'$	$kg/m^3$	DENSITY OF SUBMERGED SOIL	APL		ABOUT PLASTIC LIMIT	k	m/s	HYDRAULIC CONDUCTIVITY
$\gamma'$	$kN/m^3$	UNIT WEIGHT OF SUBMERGED SOIL	WTPL		WETTER THAN PLASTIC LIMIT	j	$kN/m^3$	SEEPAGE FORCE
e	1, %	VOID RATIO						

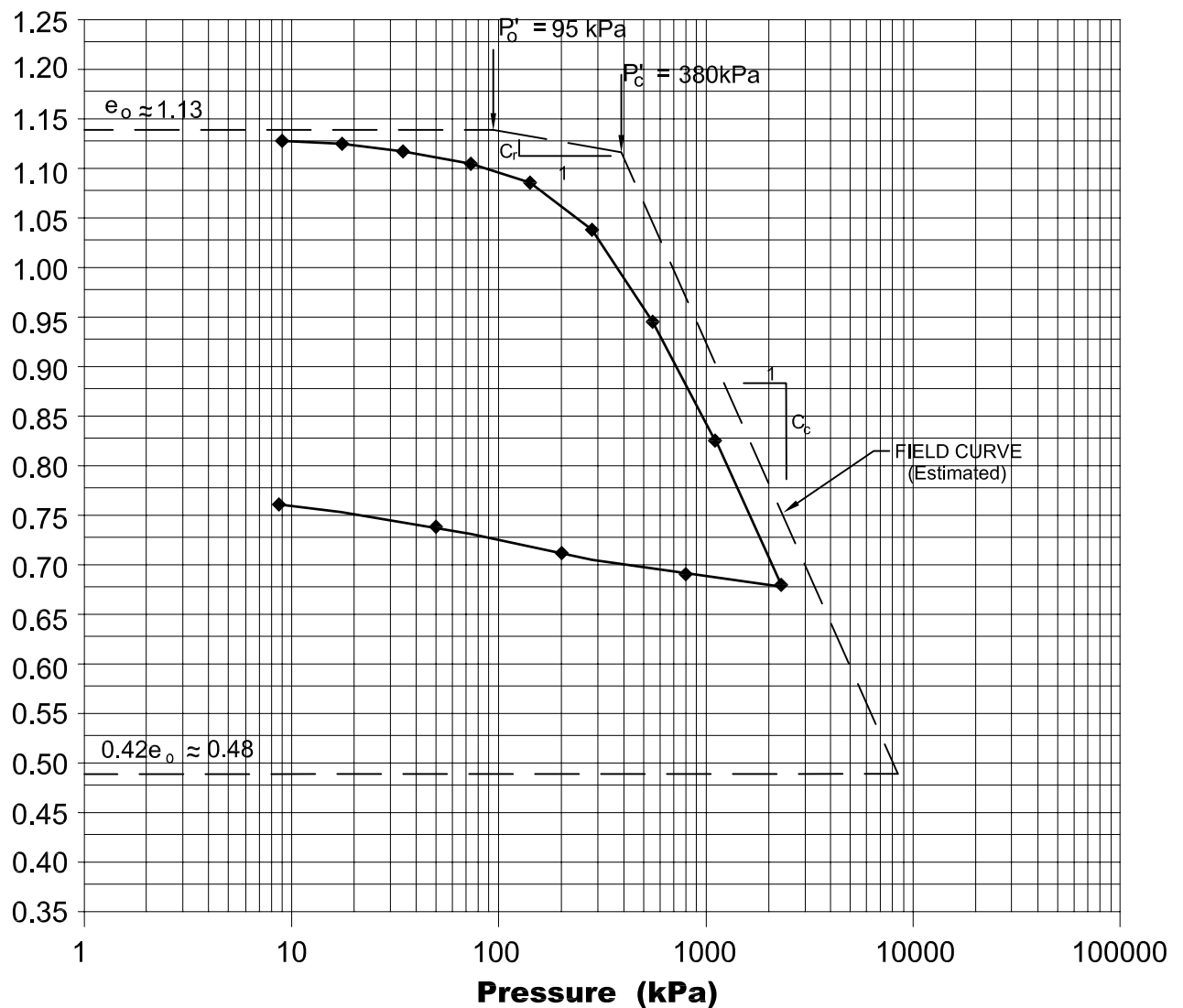
Ungulate Guard at Sta. 9+710 Highway 637 Servos Road, Servos Township

# Laboratory Consolidation Test Results

Ungulate Guard at STA. 9+710  
Highway 637 Service Road

Borehole 3, Sample 6  
Depth 4.6 - 5.2 m (El. 232.5 to 231.9)

## Void Ratio versus Log of Pressure



SOIL TYPE: CLAYEY SILT, trace sand, trace gravel

$e_0 \approx 1.13$

$W_0 = 40\%$

$\gamma = 17.5$  kN/m<sup>3</sup>

$P'_0 = 95$  kPa

$P'_c = 380$  kPa

$C_c = 0.47$

$C_r = 0.037$

$W_L = 34$

$W_p = 20$

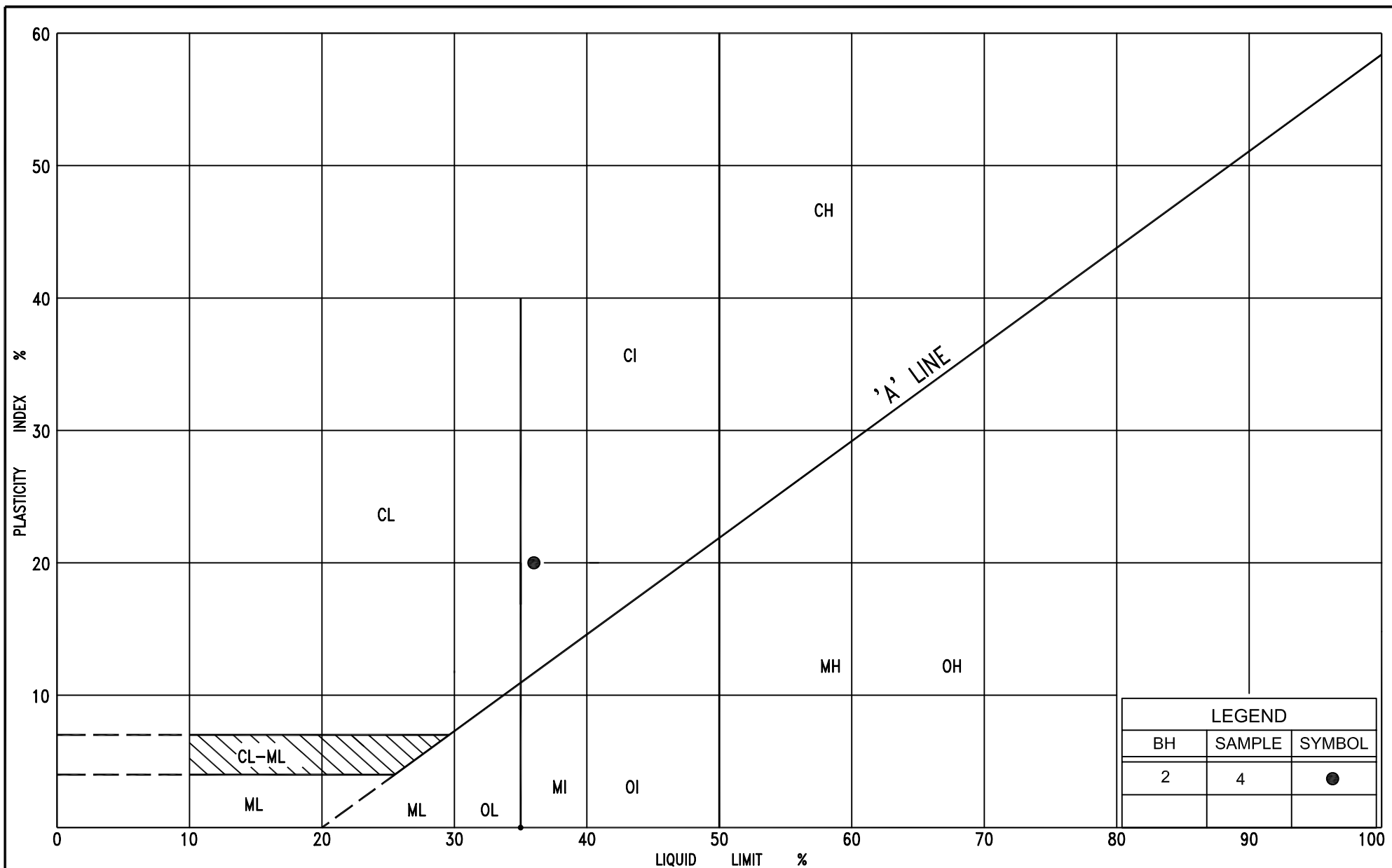
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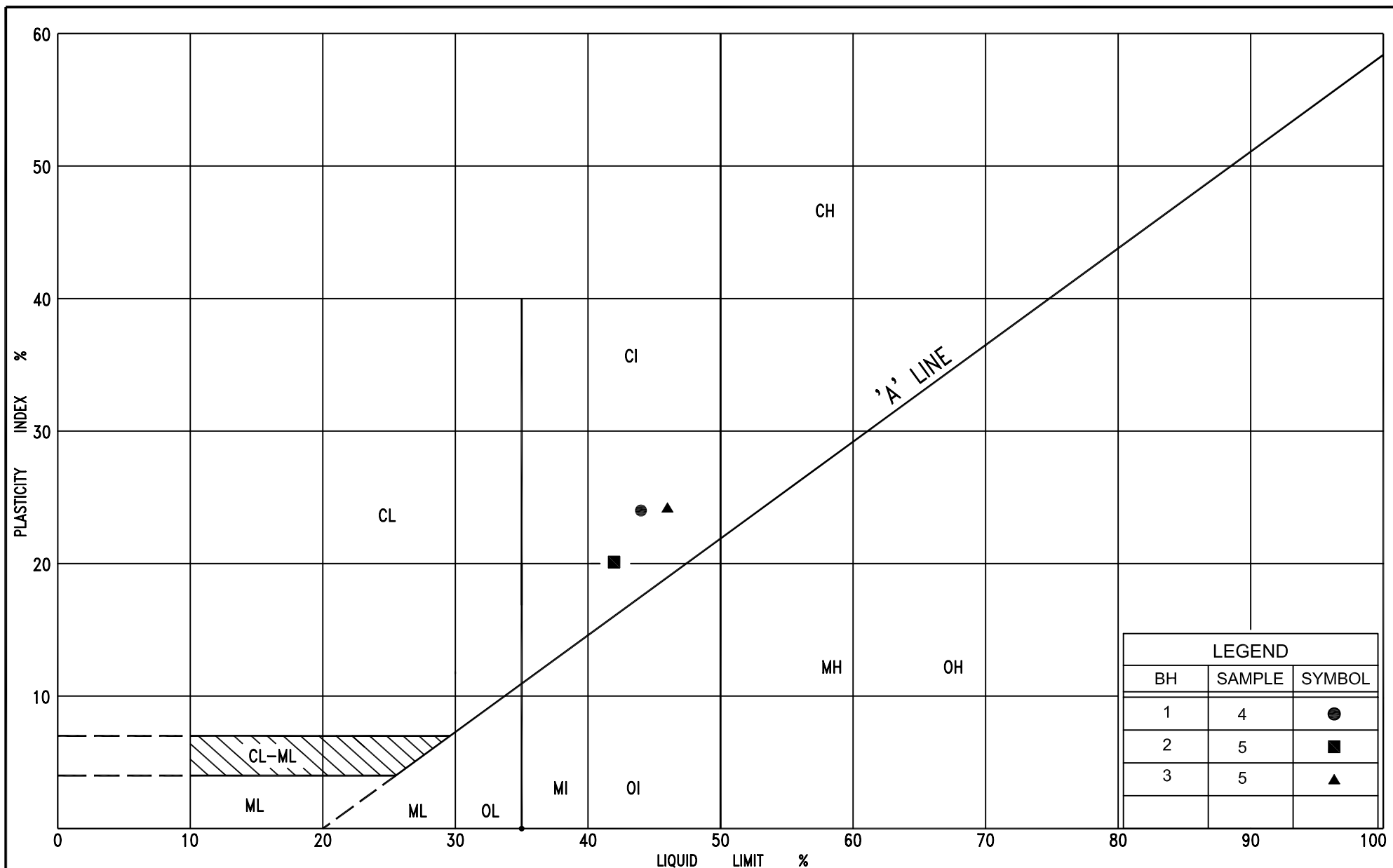
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HIGHWAY: 69

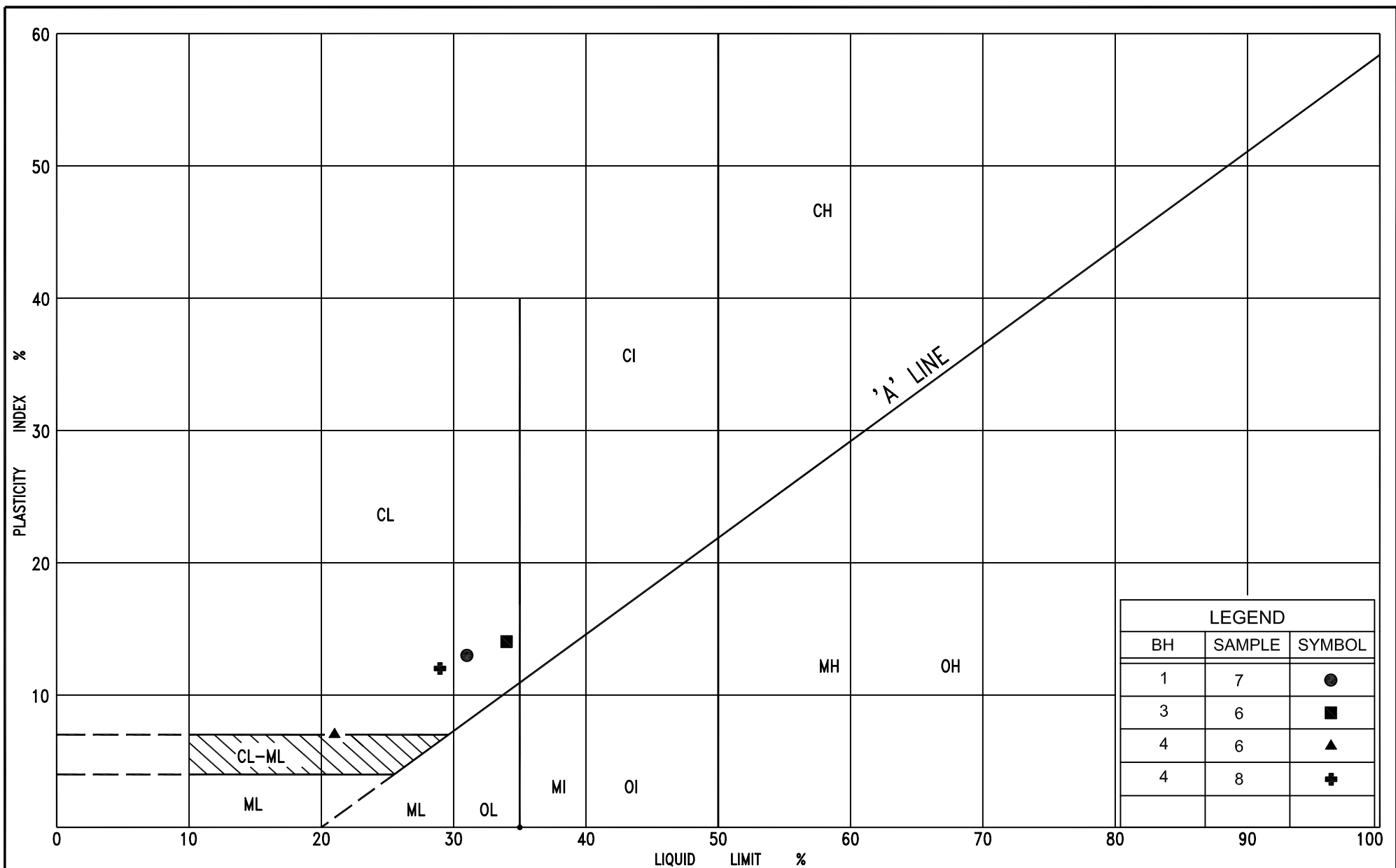
TOWNSHIP: SERVOS

G.W.P. 5218-06-00

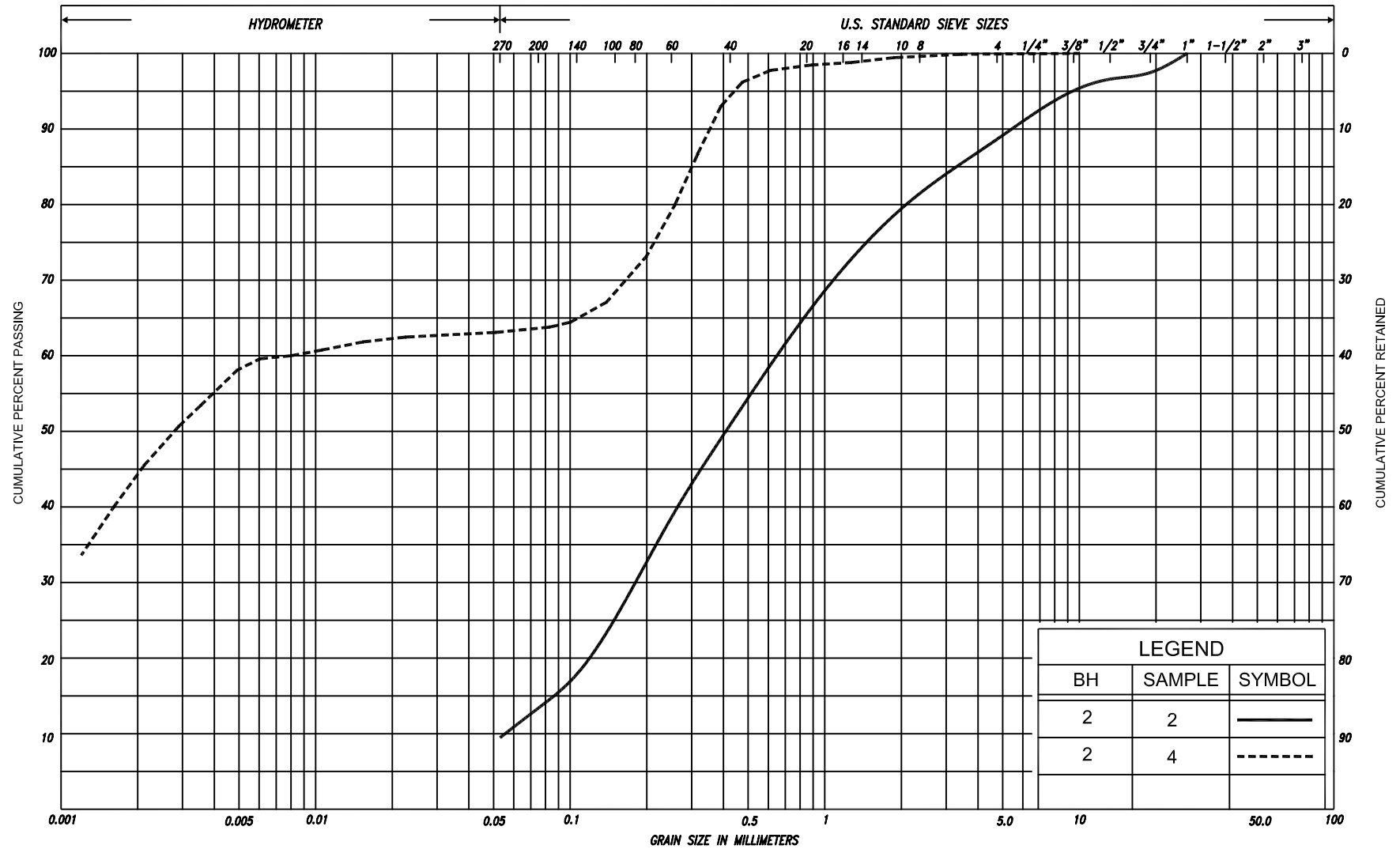




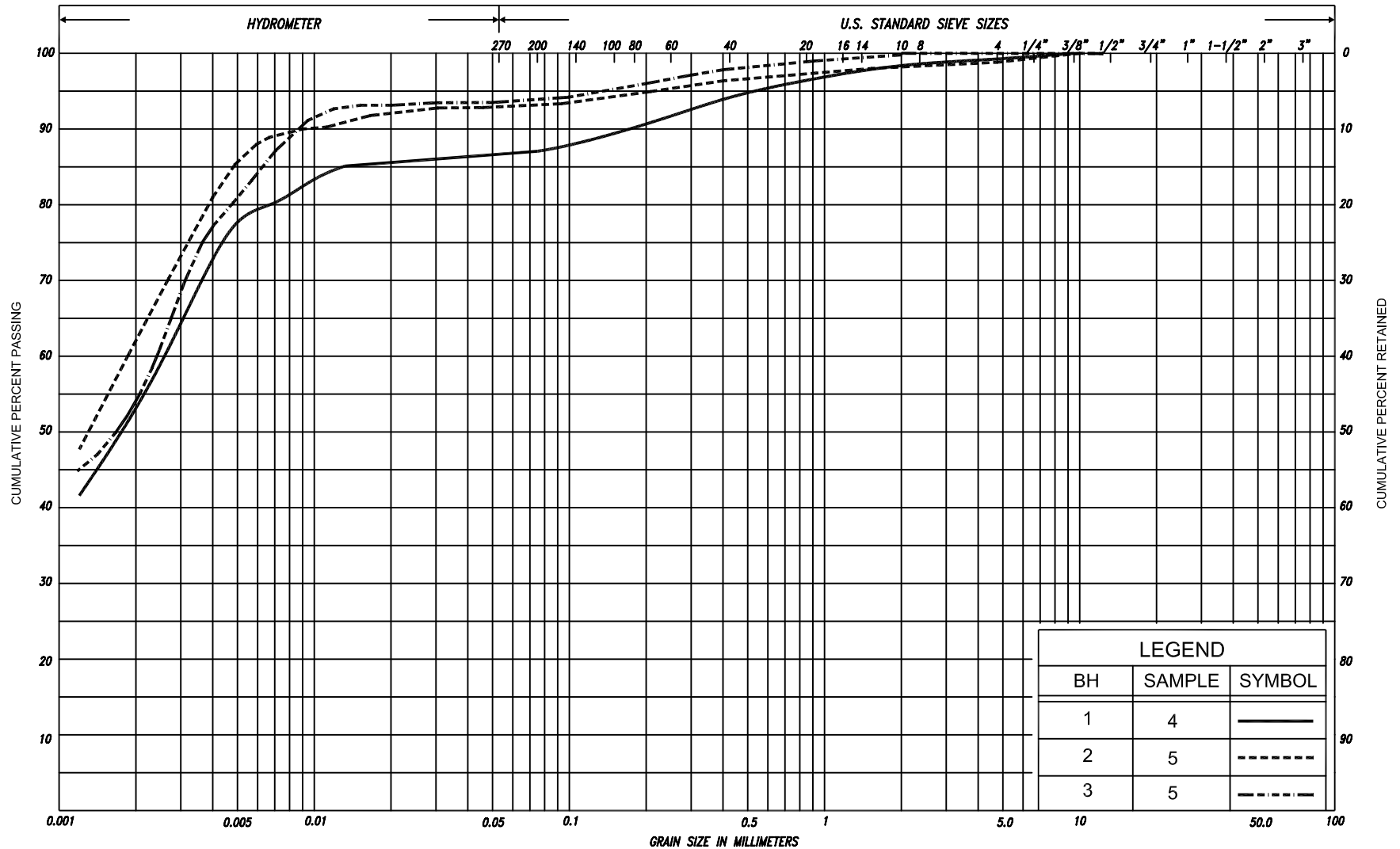
LEGEND		
BH	SAMPLE	SYMBOL
1	4	●
2	5	■
3	5	▲



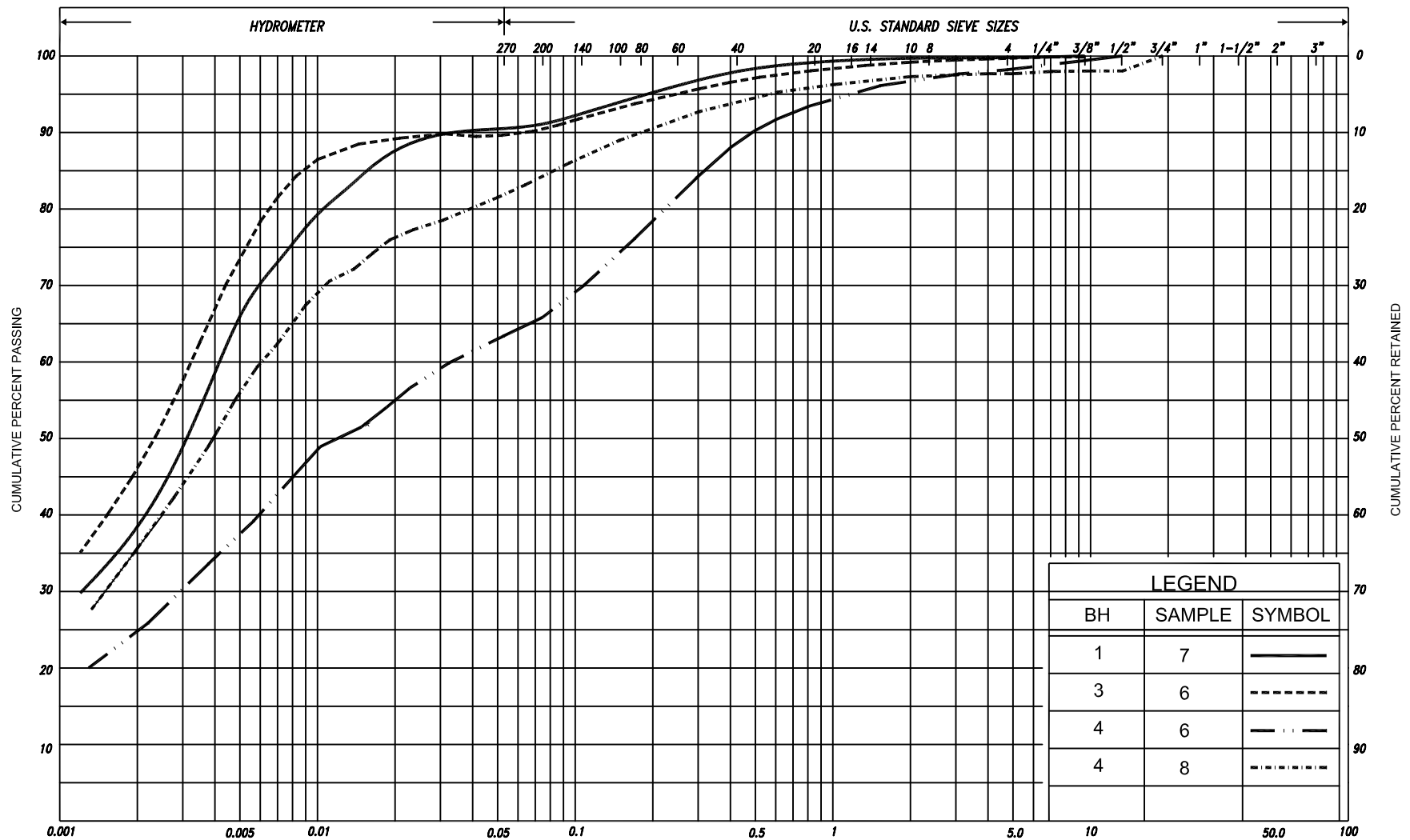




SILT & CLAY				FINE		MEDIUM		COARSE		GRAVEL				COBBLES	UNIFIED	
				SAND												
CLAY	FINE		MEDIUM		COARSE		FINE		MEDIUM		COARSE		GRAVEL		COBBLES	M.I.T.
	SILT															
CLAY		SILT			V. FINE	FINE	MED.	COARSE		GRAVEL						U.S. BUREAU
					SAND											



SILT & CLAY				FINE		MEDIUM		COARSE		GRAVEL				COBBLES	UNIFIED		
				SAND													
CLAY	FINE		MEDIUM		COARSE		FINE		MEDIUM		COARSE		GRAVEL			COBBLES	M.I.T.
	SILT																
CLAY			SILT			V. FINE	FINE	MED.	COARSE		GRAVEL					U.S. BUREAU	
						SAND											



SILT & CLAY				FINE		MEDIUM		COARSE	GRAVEL		COBBLES	UNIFIED
CLAY	FINE		MEDIUM	COARSE	FINE		MEDIUM	COARSE	GRAVEL		COBBLES	M.I.T.
	SILT				SAND							
CLAY		SILT		V. FINE		FINE	MED.	COARSE	GRAVEL			U.S. BUREAU
						SAND						

# RECORD OF BOREHOLE No 1

1 of 1

**METRIC**

G.W.P. 5218-06-00 LOCATION Ungulate Guard, Hwy 637 Service Road, Sta. 9+708, o/s 5.5m Rt.  
 Coords: 5 121 061.7 N; 321 780.2 E ORIGINATED BY F.P.  
 DIST 54 HWY 637 BOREHOLE TYPE C.F.S.S.A. + WASH BORING + ROTARY DIAMOND CORING COMPILED BY M.N.  
 DATUM Geodetic DATE April 30, 2009 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		SHEAR STRENGTH kPa										WATER CONTENT (%)		
							○ UNCONFINED		+ FIELD VANE		● QUICK TRIAXIAL						× LAB VANE		
237.1	Ground surface					20	40	60	80	100	20	40	60			GR SA SI CL			
0.0	Sand and gravel trace to some silt Loose Brown Moist		1	SS	8						○					1 12 34 53			
	Sand some gravel, cobbles Compact		2	SS	19						○								
	(FILL)																		
	Wet		3	SS	5						○								
235.0																			
2.1	Silty clay some sand, trace gravel organic inclusions to 3.0m Very stiff Mottled Moist to stiff grey/brown		4	SS	14						○	—	—						
			5	SS	5							○							
233.3																			
3.8	Clayey silt, trace sand Firm Grey Wet		6	SS	4							—	—	○					
			7	SS	3														
				FV															
			8	SS	3														
				FV															
229.9																			
7.2	Pyroxenite Bedrock Slightly weathered to unweathered Medium to high strength Good quality		9	RC NQ	REC 83%											RQD 83%			
			10	RC NQ	REC 96%											RQD 83%			
	Medium strength Poor quality		11	RC NQ	REC 93%											RQD 44%			
226.6																			
10.5	End of borehole																		
															</				

# RECORD OF BOREHOLE No 2

1 of 1

**METRIC**

G.W.P. 5218-06-00 LOCATION Ungulate Guard, Hwy 637 Service Road, Sta. 9+708, o/s 4.5m Lt.  
 Coords: 5 121 070.4 N; 321 785.2 E ORIGINATED BY F.P.  
 DIST 54 HWY 637 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY M.N.  
 DATUM Geodetic DATE May 11, 2009 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT  γ  kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					w <sub>p</sub>	w	w <sub>L</sub>		
								○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL    × LAB VANE									
								20	40	60	80	100					
237.2	Ground surface																
0.0	150 mm asphalt over sand and gravel, trace silt						237										
236.5	(PAVEMENT FILL)		1	SS	20/5cm												
0.7	Sand some gravel, some silt		2	SS	28		236						○				12 74 (14)
	Compact Brown Moist																
			3	SS	17								○				
	Sandy silty clay organic inclusions						235										
	Stiff Dark grey (FILL) Moist		4	SS	12								○				0 36 20 44
234.2																	
3.0	Silty clay trace sand, trace gravel		5	SS	5		234										1 6 31 62
	Stiff Grey Moist			FV													
233.0							233										
4.2	Clayey silt trace sand, travel gravel																
	Firm Grey Wet		6	SS	2		232								○		
				FV													
	sand layers						231								○		
				FV													
229.9							230										
7.3	Sand some gravel, trace silt																
229.4	Dense Grey Wet		8	SS	8/5cm												
7.8	End of borehole																
	Refusal on probable bedrock																
	Samples 1 & 8: Sampler bouncing																
	* 2009 05 11																
	▽ Water level observed during drilling																
	▼ Water level measured after drilling																
	■ Penetrometer test																

<b>RECORD OF BOREHOLE No 3</b>										1 of 1		<b>METRIC</b>					
G.W.P. 5218-06-00			LOCATION			Ungulate Guard, Hwy 637 Service Road, Sta. 9+712, o/s 5.5m Rt. Coords: 5 121 059.7 N; 321 783.6 E			ORIGINATED BY F.P.								
DIST 54 HWY 637			BOREHOLE TYPE C.F.S.S.A. + WASH BORING						COMPILED BY M.N.								
DATUM Geodetic			DATE May 01, 2009						CHECKED BY C.N.								
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		ELEVATION SCALE	SHEAR STRENGTH kPa									
237.1	Ground surface						20 40 60 80 100	○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					WATER CONTENT (%)				
0.0	Sand and gravel trace to some silt  Sand _____ Brown _____ Moist _____ some gravel, cobbles Loose to compact  _____ (FILL) _____ pockets of silty clay		1	SS	7		20 40 60 80 100										
			2	SS	12												
235.0			3	SS	5												
2.1	Silty clay, trace sand trace gravel to 4.3m  Very stiff Grey/ _____ Moist _____ to stiff brown		4	SS	10												
			5	SS	4												
				FV													
232.8	Clayey silt trace sand, trace gravel  Firm _____ Grey _____ Wet _____		6	TW	PH												
4.3				FV													
			7	SS	1												
				FV													
229.8	Sand some gravel, trace silt  Compact _____ Brown _____ Wet _____		8	SS	22												
7.3																	
228.7	End of borehole Refusal on probable bedrock																
8.4																	

\* 2009 05 1

▽ Water level observed during drilling

■ Penetrometer test

C.F.S.S.A. denotes Continuous Flight Solid Stem Augers

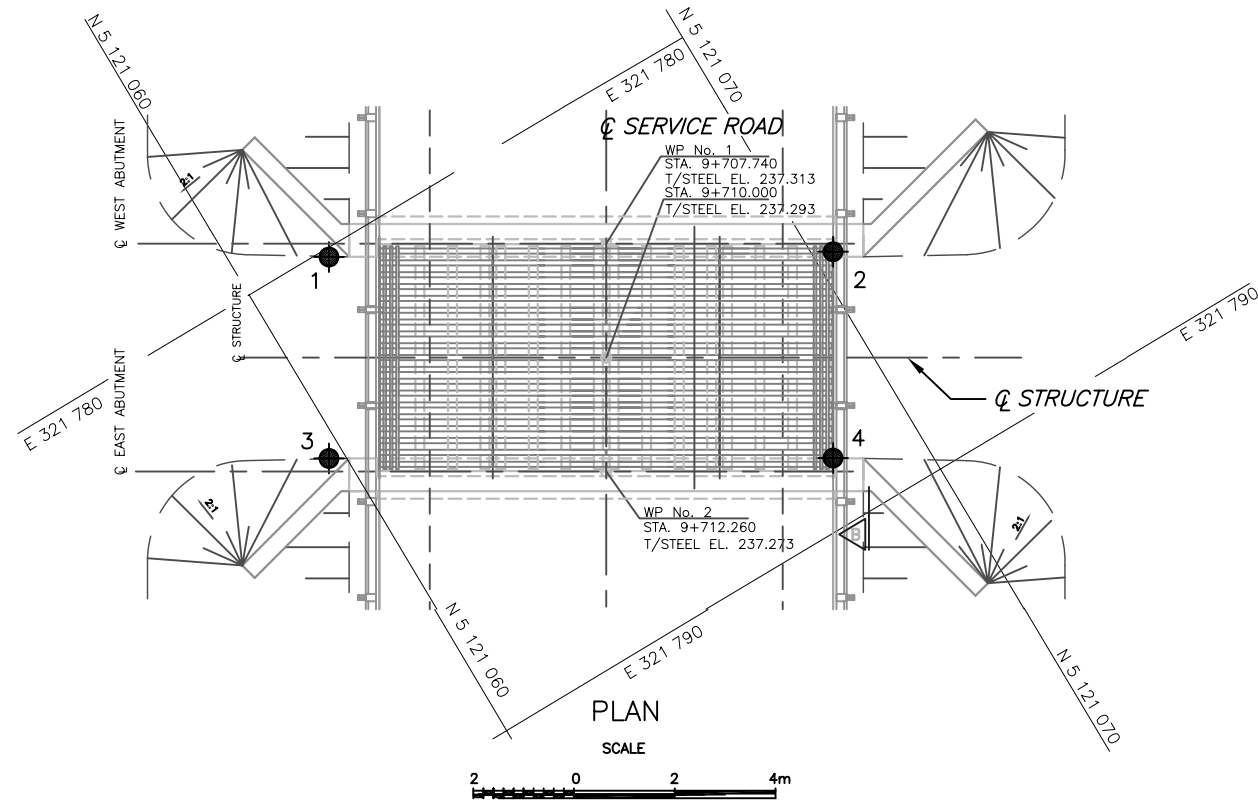
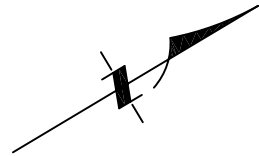
**RECORD OF BOREHOLE No 4**

1 of 1

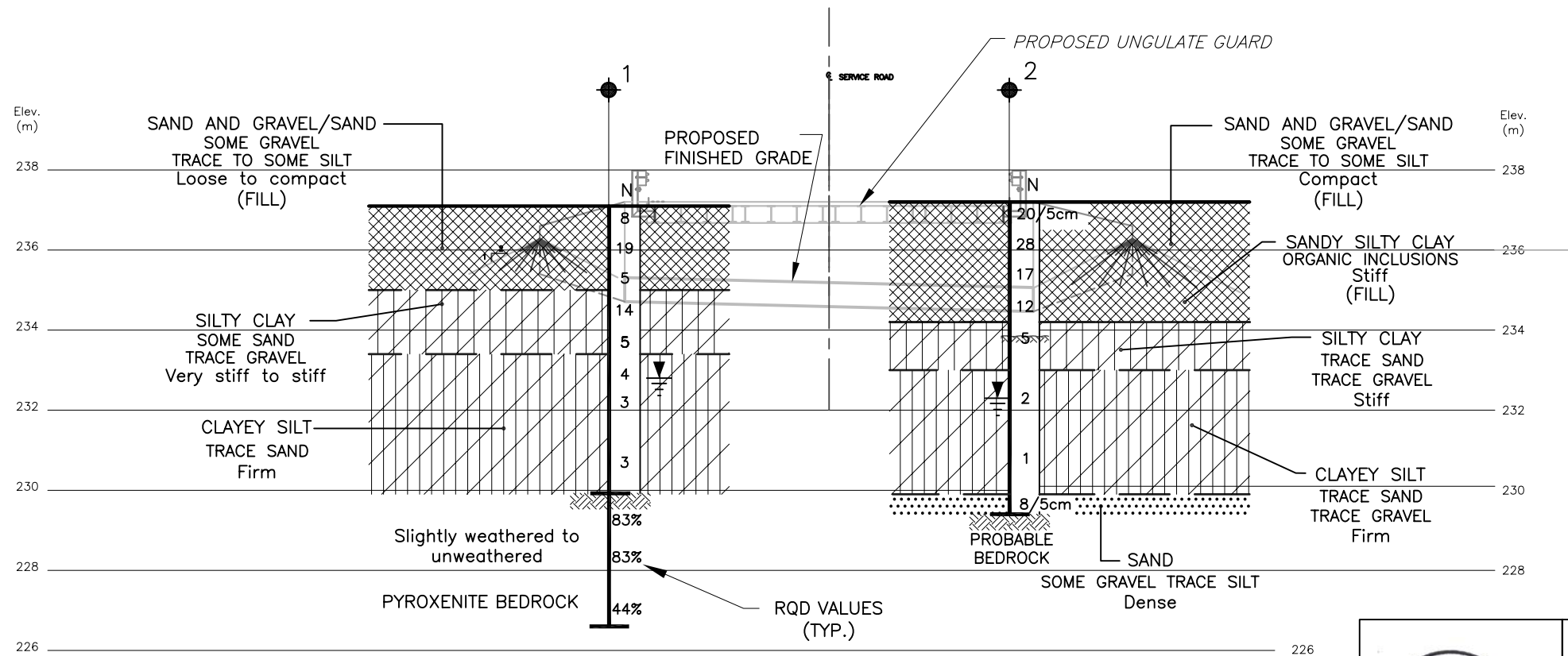
**METRIC**

G.W.P. 5218-06-00 LOCATION Ungulate Guard, Hwy 637 Service Road, Sta. 9+712, o/s 4.5m Lt.  
Coords: 5 121 068.3 N; 321 788.7 E ORIGINATED BY F.P.  
DIST 54 HWY 637 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY M.N.  
DATUM Geodetic DATE May 11, 2009 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa											
								○ UNCONFINED      + FIELD VANE											
								● QUICK TRIAXIAL    × LAB VANE											
					WATER CONTENT (%)														
					20    40    60    80    100					20    40    60									
237.2	Ground surface																		
0.0	150 mm asphalt over sand and gravel trace silt		1	SS	12/15cm														
236.4	Brown Moist (PAVEMENT FILL)		2	SS	13/15cm														
0.8	Sand some gravel, some silt Compact (FILL)		3	SS	21														
235.1	Silty clay trace sand, trace gravel Very stiff Mottled Moist to firm grey / brown		4	SS	14														
2.1			5	SS	7														
233.4	Clayey silt sandy, trace gravel Stiff to Grey Wet soft		6	TW	PH														
3.8			FV																
			7	SS	2														
	some sand																		
			8	TW	PH														
			FV																
229.9	Sand some gravel, trace silt Dense Grey Wet		9	SS	34														
7.3																			
229.1	End of borehole Refusal on probable bedrock																		
8.1	Samples 1 & 2: Sampler bouncing																		
	*    2009   05   11																		
	▽    Water level observed during drilling																		
	▼    Water level measured afterdrilling																		
	■    Penetrometer test																		



PLAN  
SCALE  
0 2 4m



PROFILE  $\varnothing$  UNGULATE GUARD AT STA. 9+710  
SCALE  
0 2 4m

NOTE:

THIS DRAWING IS FOR SUBSURFACE INFORMATION ONLY. SURFACE DETAILS AND FEATURES ARE FOR CONCEPTUAL ILLUSTRATION.



REF No.: TSH DRAWING  
91088-HWY 637 SERVICE RD.-1-N,-UNGULATE GUARD  
-9+710-1-GA.dwg; dated May, 2009.

METRIC  
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES UNLESS  
OTHERWISE SHOWN. STATIONS  
IN KILOMETRES + METRES

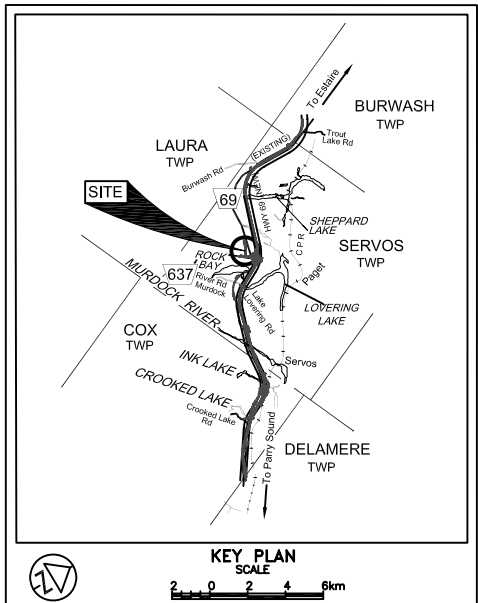
CONT No 2009-5131  
WP No 5394-08-01

UNGULATE GUARD AT STA. 9+710

HIGHWAY 637 SERVICE ROAD - SERVOS TWP

BOREHOLE LOCATIONS AND SOIL STRATA

**PMI Peto MacCallum Ltd.**  
CONSULTING ENGINEERS



LEGEND	
	Borehole
	Dynamic Cone Penetration Test (Cone)
	Borehole & Cone
N	Blows/0.3m (Std. Pen Test, 475 J/blow)
CONE	Blows/0.3m (60° Cone, 475 J/blow)
	W L at time of investigation Apr. May, 2009
	Head
	ARTESIAN WATER
	Encountered
	PIEZOMETER

BH No	ELEVATION	CO-ORDS	
		NORTHING	EASTING
1	237.1	5 121 061.7	321 780.2
2	237.2	5 121 070.4	321 785.2
3	237.1	5 121 059.7	321 783.6
4	237.2	5 121 068.3	321 788.7

The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

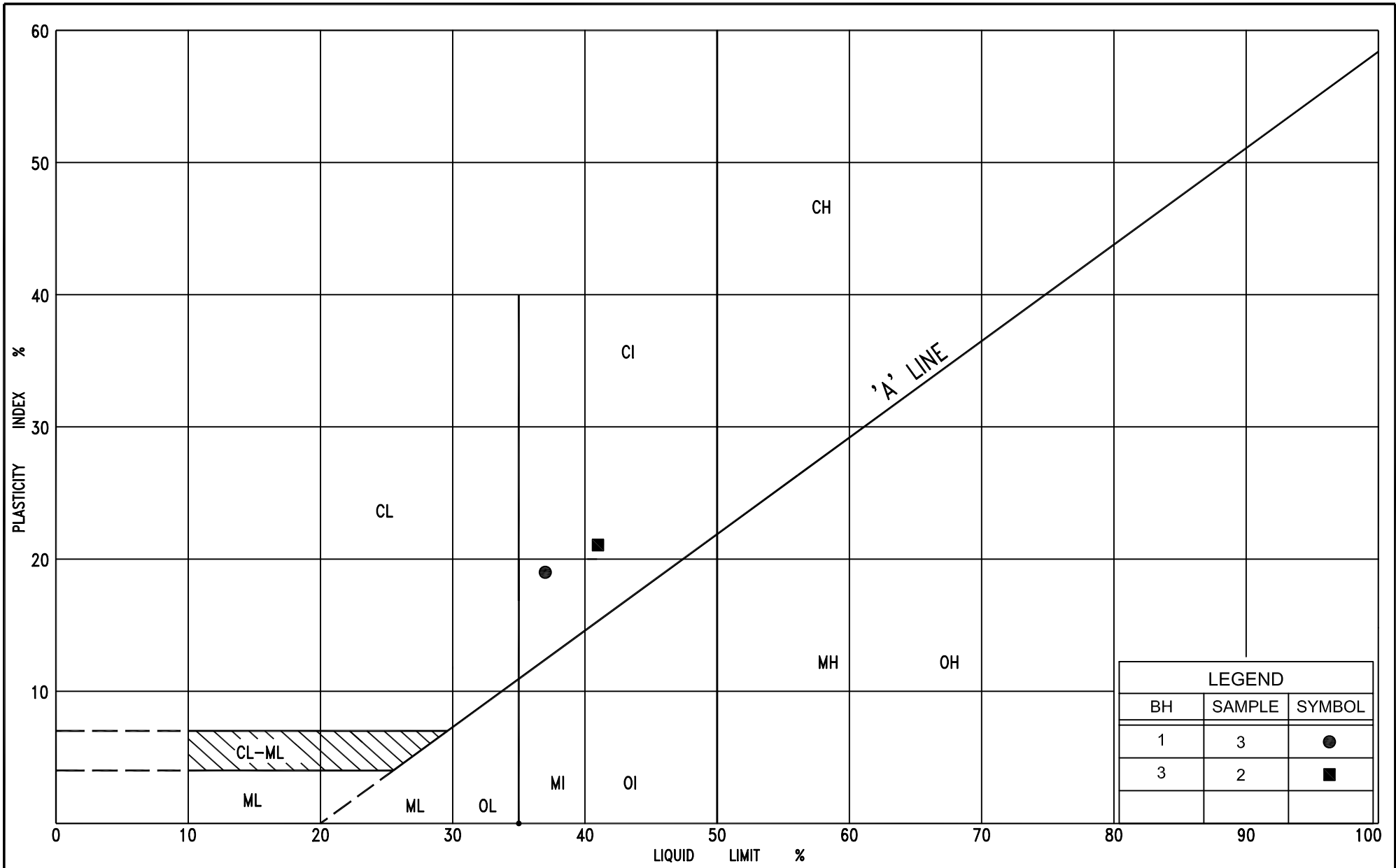
REVISIONS	DATE	BY	DESCRIPTION

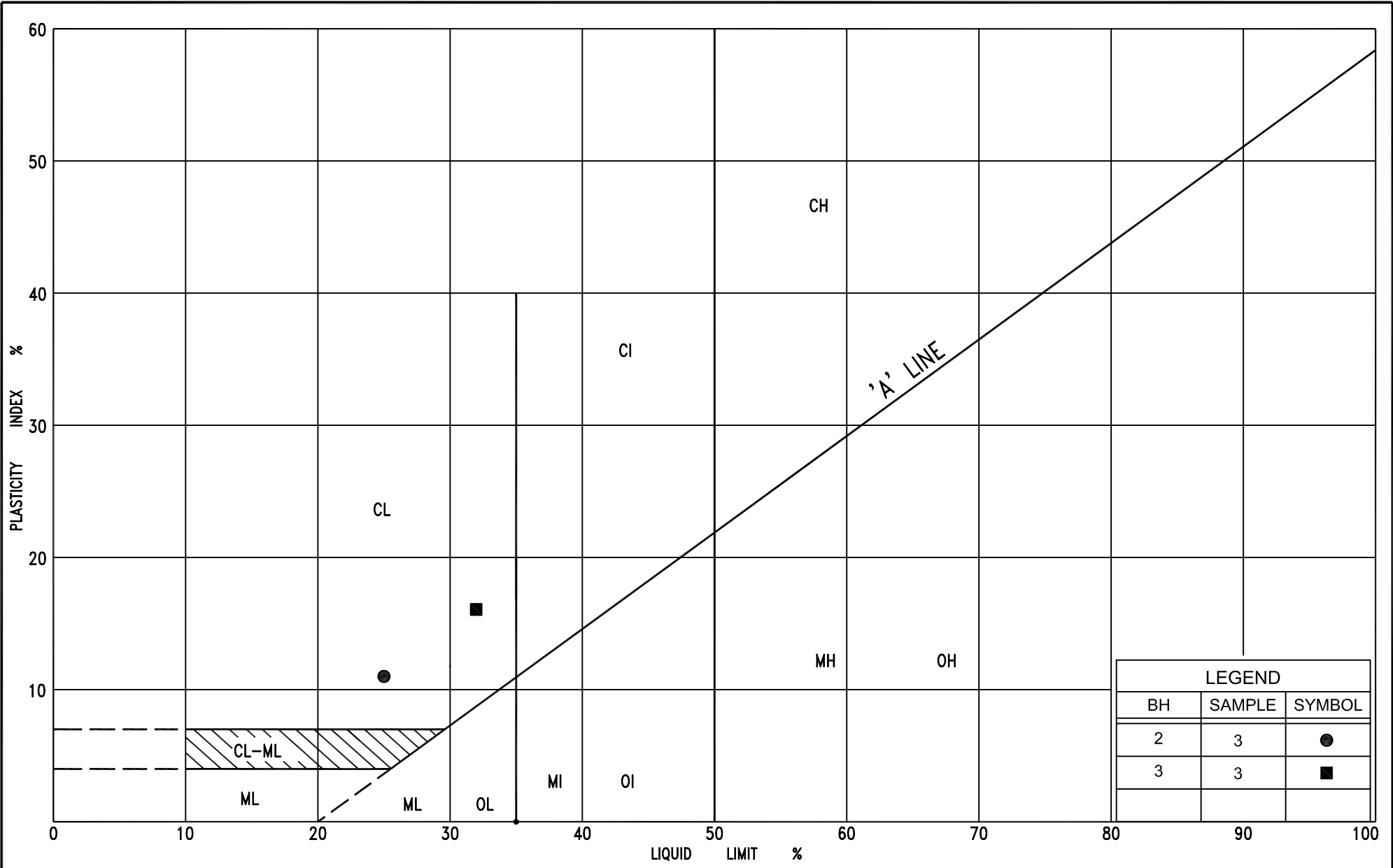
Geocres No. 411-240

HWY No	69	DIST	54
SUBMIT	MN	CHECKED	CN
DRAWN	NA	CHECKED	CN
APPROVED	BRG	DATE	JULY 27, 2009
SITE	---	DWG	UG-1-1



Ungulate Guard at Sta. 10+033.5 Highway 637 Servos Road, Servos Township





Ministry of  
Transportation  
Ontario

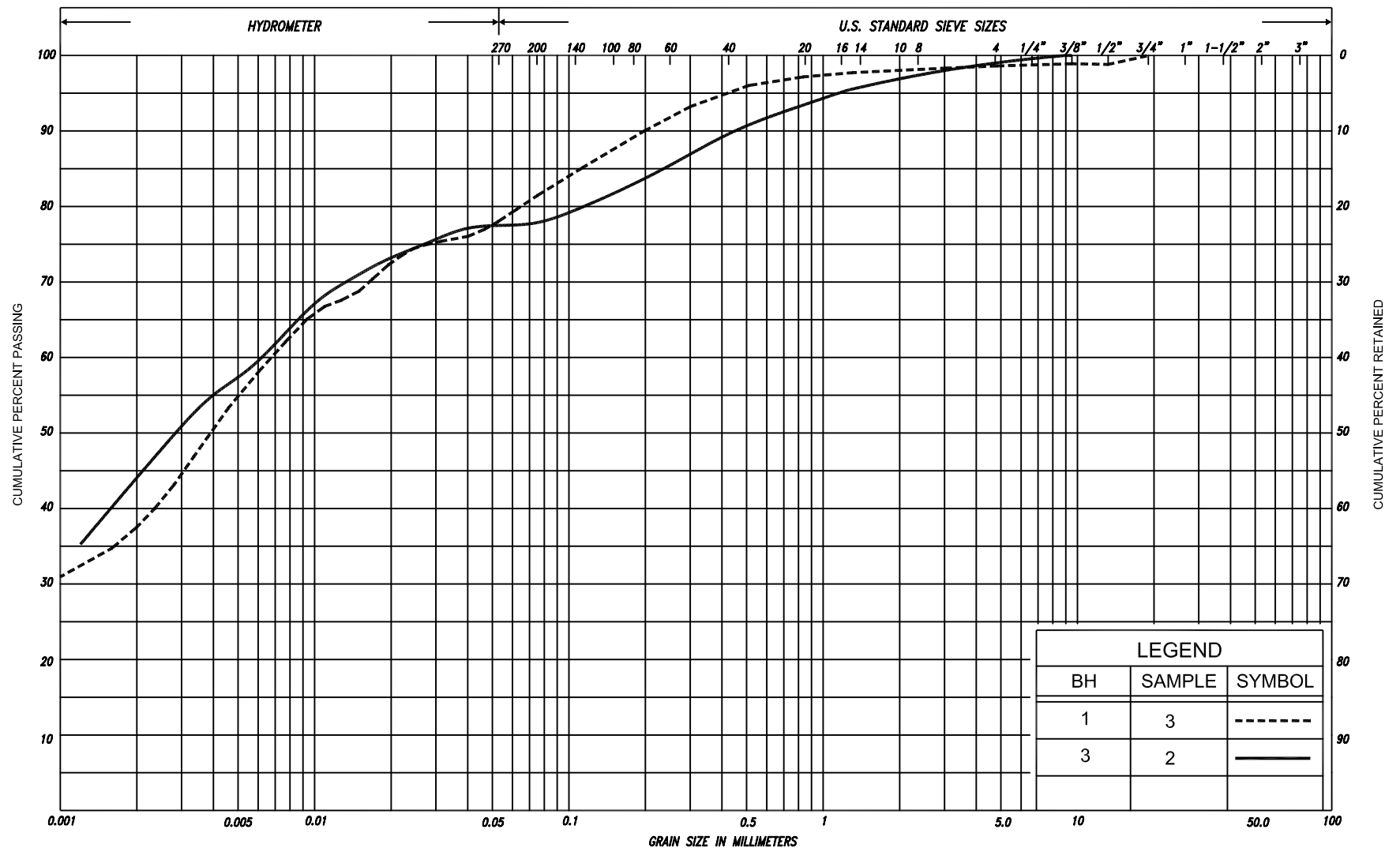
## PLASTICITY CHART

CLAYEY SILT, with sand to sandy, trace gravel

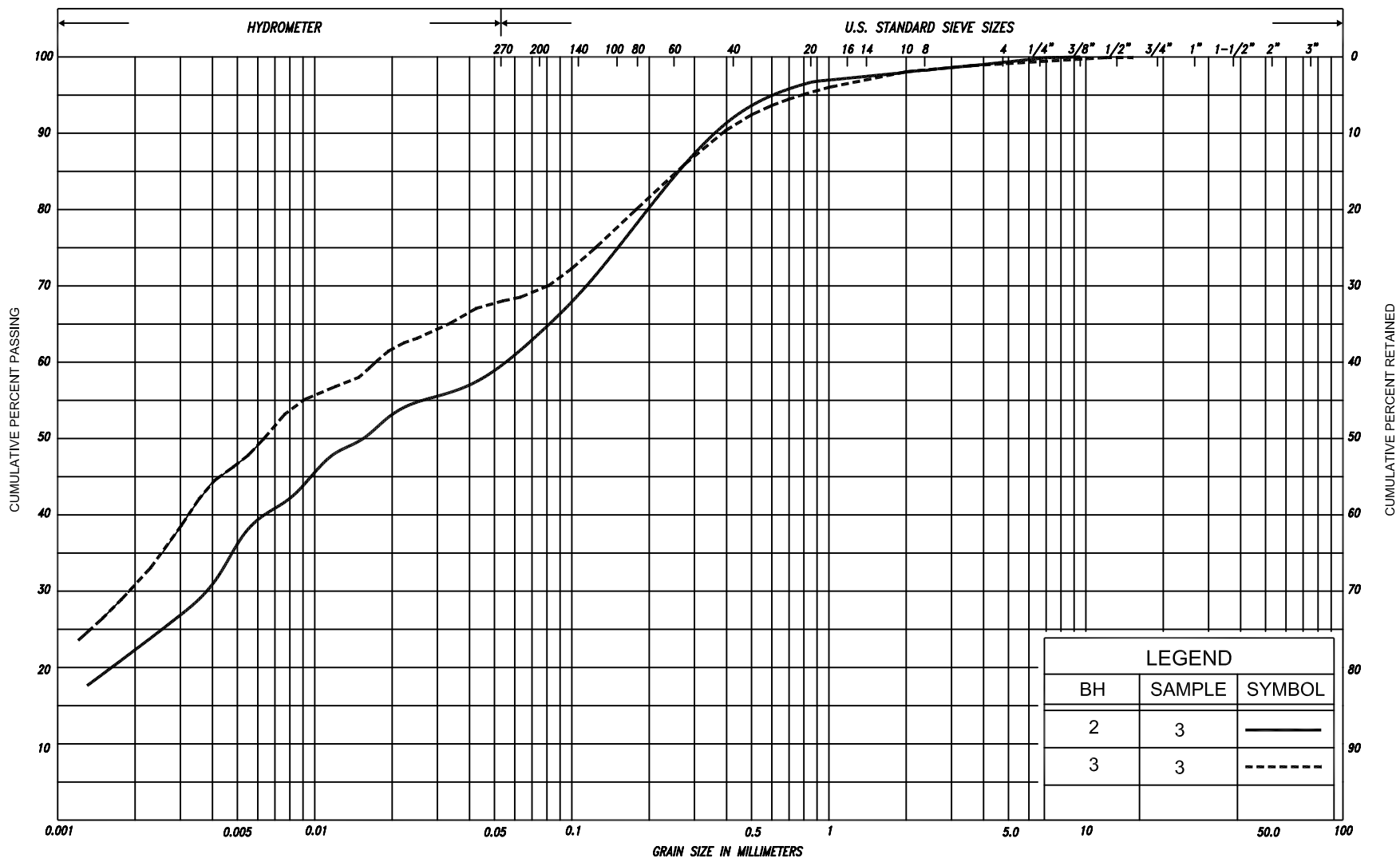
FIG No. PC-UG-2-2

HWY: 637-Service Road

G.W.P. No. 5218-06-00



SILT & CLAY				FINE		MEDIUM		COARSE	GRAVEL		COBBLES	UNIFIED
CLAY	FINE		MEDIUM	COARSE	FINE		MEDIUM	COARSE	GRAVEL		COBBLES	M.I.T.
	SILT			SAND					GRAVEL		COBBLES	U.S. BUREAU
CLAY		SILT		V. FINE	FINE	MED.	COARSE	GRAVEL				U.S. BUREAU
				SAND								



SILT & CLAY				FINE			MEDIUM			COARSE			GRAVEL		COB BLES	UNIFIED
CLAY	FINE			MEDIUM			COARSE			GRAVEL			COBBLES		M.I.T.	
	SILT			SAND			SAND			SAND			GRAVEL		U.S. BUREAU	

# RECORD OF BOREHOLE No 1

1 of 1

**METRIC**

G.W.P. 5218-06-00 LOCATION Ungulate Guard, Hwy 637 Service Road, Sta. 10+035, o/s 4.5m Rt.  
Coords: 5 120 822.9 N; 321 989.6 E ORIGINATED BY F.P.  
DIST 54 HWY 637 BOREHOLE TYPE C.F.S.S.A. AND ROTARY DIAMOND CORING COMPILED BY M.N.  
DATUM Geodetic DATE April 29, 2009 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS *	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	*N* VALUES			SHEAR STRENGTH kPa											
								○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL    × LAB VANE											
231.9 0.0	Ground surface							20	40	60	80	100							
	Sand and gravel, trace silt		1	SS	5														
	Loose    Brown    Moist gravelly sand, with silt topsoil inclusions																		
230.8 1.1	(FILL)		2	SS	7			231											
	Silty clay some sand, trace gravel																		
	Stiff to    Brown    Moist very stiff		3	SS	25			230						200					1 18 44 37
			4	SS	20/3cm														
229.6 2.3	Granitic Gneiss Bedrock																		
	Slightly weathered to unweathered		5	RC NQ	REC 90%	229											RQD 90%		
	High strength																		
	Excellent quality		6	RC NQ	REC 94%	228											RQD 94%		
			7	RC NQ	REC 99%												RQD 96%		
226.5 5.4	End of borehole		8	RC NQ	REC 100%	227											RQD 100%		
	Sample 4: Sampler bouncing																		
	*    Borehole charged with drilling water																		
	■    Penetrometer test																		
	C.F.S.S.A. denotes Continuous Flight Solid Stem Augers																		

# RECORD OF BOREHOLE No 2

1 of 1

**METRIC**

G.W.P. 5218-06-00 LOCATION Ungulate Guard, Hwy 637 Service Road, Sta. 10+035 CL  
 Coords: 5 120 825.5 N; 321 993.3 E ORIGINATED BY F.P.  
 DIST 54 HWY 637 BOREHOLE TYPE CONTINUOUS FLIGHT SOLID STEM AUGERS COMPILED BY M.N.  
 DATUM Geodetic DATE April 30, 2009 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS *	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	*N* VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE												
231.9 0.0	Ground surface							20	40	60	80	100								
	Sand and gravel, trace silt		1	SS	8									○						
	Loose      Brown      Moist																			
231.0 0.9	gravelly sand, with silt																			
	(FILL)		2	SS	13		231							○						
230.4 1.5	Silty clay some sand, trace gravel																			
	Stiff      Mottled Moist grey/brown		3	SS	20									○			1 35 42 22			
229.8 2.1	Clayey silt, sandy trace gravel						230													
	Stiff      Mottled Moist grey/brown																			
	End of borehole																			
	Refusal on probable bedrock																			
	 *      Borehole dry																			

**RECORD OF BOREHOLE No 3**

1 of 1

**METRIC**

Ungulate Guard, Hwy 637 Service Road, Sta. 10+035, o/s 4.5m Lt.

Coords: 5 120 828.0 N; 321 997.0 E

G.W.P. 5218-06-00

LOCATION

ORIGINATED BY F.P.

DIST 54

HWY 637

BOREHOLE TYPE

C.F.S.S.A. AND ROTARY DIAMOND DRILLING

COMPILED BY M.N.

DATUM Geodetic

DATE

April 30, 2009

CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS *	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	*N* VALUES			SHEAR STRENGTH kPa									
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
231.9	Ground surface						20	40	60	80	100						
0.0	Sand and gravel, trace silt		1	SS	7												
	Loose _____ Moist																
	gravelly sand, with silt																
230.8	(FILL)		2	SS	6												
1.1	Silty clay, with sand																
230.5																	
1.4	Firm _____ Mottled Moist		3	SS	21												
	grey/brown																
230.0	Clayey silt, with sand																
1.9	Very stiff _____ Mottled Moist																
	grey/brown																
	Granitic Gneiss Bedrock		4	RC	REC												
	Slightly weathered to			NQ	100%												
	unweathered																
	High strength																
	Excellent quality		5	RC	REC												
				NQ	100%												
227.0	End of borehole																
4.9																	
	Sample 3: Sampler bouncing																
	* Borehole charged with drilling water																
	■ Penetrometer test																
	C.F.S.S.A. denotes Continuous Flight Solid Stem Augers																



**RECORD OF BOREHOLE No 4**

1 of 1

**METRIC**

Ungulate Guard, Hwy 637 Service Road, Sta. 10+043, o/s 4.5m Rt.

Coords: 5 120 816.3 N; 321 994.1 E

G.W.P. 5218-06-00

LOCATION

ORIGINATED BY F.P.

DIST 54

HWY 637

BOREHOLE TYPE C.F.S.S.A. AND ROTARY DIAMOND CORING



COMPILED BY M.N.

DATUM Geodetic

DATE

April 29, 2009

CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS *	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										
								○ UNCONFINED	+	FIELD VANE								
						● QUICK TRIAXIAL	×	LAB VANE	WATER CONTENT (%)									
231.4	Ground surface																	
0.0	Topsoil																	
231.2	Clayey silt some sand, trace gravel		1	SS	5		231											
0.2	Firm to Brown Moist very stiff																	
	Mottled grey/brown	2	SS	14														
229.6			3	SS	15/8cm	230												
1.8	Granitic Gneiss Bedrock		4	RC NQ	REC 98%	229												
	Slightly weathered to unweathered																	
	High Strength																	
	Good to excellent quality		5	RC NQ	REC 100%	228												
226.6			6	RC NQ	REC 100%	227												
4.8	End of borehole																	
	Sample 3: Sampler bouncing																	
	* Borehole charged with drilling water																	
	■ Penetrometer test																	
	C.F.S.S.A. denotes Continuous Flight Solid Stem Augers																	

**RECORD OF BOREHOLE No 5**

1 of 1

**METRIC**

G.W.P. 5218-06-00 LOCATION Ungulate Guard, Hwy 637 Service Road, Sta. 10+043 CL  
 Coords: 5 120 818.9 N; 321 997.9 E ORIGINATED BY F.P.  
 DIST 54 HWY 637 BOREHOLE TYPE CONTINUOUS FLIGHT SOLID STEM AUGERS COMPILED BY M.N.  
 DATUM Geodetic DATE April 30, 2009 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS *	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	*N* VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE												
231.3	Ground surface							20	40	60	80	100								
0.0 231.0	Topsoil		1	SS	9		231							○						
0.3	Clayey silt some sand, trace gravel																			
230.1	Stiff to Mottled Moist very stiff grey/brown thin layers of sand		2	SS	18/23cm								138	●						
1.2	End of borehole																			
	Refusal on probable bedrock																			
	Sample 2: Sampler bouncing																			
	* Borehole dry																			
	■ Penetrometer test																			

<b>RECORD OF BOREHOLE No 6</b> <span style="float: right;">1 of 1 <b>METRIC</b></span>																
G.W.P. 5218-06-00		LOCATION		Ungulate Guard, Hwy 637 Service Road, Sta 10+043, o/s 4.5m Lt. Coords: 5 120 821.4 N; 322 001.6 E				ORIGINATED BY F.P.								
DIST 54 HWY 637		BOREHOLE TYPE		C.F.S.S.A. AND ROTARY DIAMOND CORING				COMPILED BY M.N.								
DATUM Geodetic		DATE		April 29, 2009				CHECKED BY C.N.								
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS *	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		SHEAR STRENGTH kPa									
231.3 0.0	Ground surface						20	40	60	80	100					
231.0 0.3	Topsoil		1	SS	3											
	Clayey silt trace sand, trace gravel															
	Soft to Mottled Moist very stiff grey/brown		2	SS	19											
229.9 1.4	Granitic Gneiss Bedrock		3	RC NQ	REC 94%											RQD 92%
	Unweathered															
	High strength															
	Excellent quality		4	RC NQ	REC 100%											RQD 93%
	50mm thick layer highly weathered															
			5	RC NQ	REC 100%											RQD 100%
226.7 4.6	End of borehole															
<p>* Borehole charged with drilling water</p> <p>C.F.S.S.A. denotes Continuous Flight Solid Stem Augers</p>																

**RECORD OF BOREHOLE No AP1**

1 of 1

**METRIC**

Ungulate Guard, Hwy 637 Service Road, Sta 10+032.5, o/s 4.5m Rt.

Coords: 5 120 825.0 N; 321 988.2 E

G.W.P. 5218-06-00

LOCATION

ORIGINATED BY F.P.

DIST 54

HWY 637

BOREHOLE TYPE

CONTINUOUS FLIGHT SOLID STEM AUGERS







COMPILED BY M.N.

DATUM Geodetic

DATE

May 12, 2009

CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			UNIT WEIGHT  γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)				
								○ UNCONFINED		+ FIELD VANE		w <sub>p</sub> w      w <sub>L</sub>				
						● QUICK TRIAXIAL	x LAB VANE									
232.1	Ground surface					*	20	40	60	80	100	20	40	60	kN/m <sup>3</sup>	GR SA SI CL
0.0	100mm asphalt over sand and gravel, trace silt						232									
231.5	Brown Moist (PAVEMENT FILL)															
0.6	Clayey silt mixed with gravelly sand															
230.8	Grey/brown (FILL)						231									
1.3	Silty clay some sand, trace gravel															
229.6	Mottled Moist grey/brown						230									
2.5	End of auger probe															
	Refusal on probable bedrock															

**RECORD OF BOREHOLE No AP2**

1 of 1

**METRIC**

G.W.P. 5218-06-00 LOCATION UngulateGuard, Hwy 637 Service Road, Sta. 10+032.5 CL  
 Coords: 5 120 827.5 N; 321 991.9 E ORIGINATED BY F.P.  
 DIST 54 HWY 637 BOREHOLE TYPE CONTINUOUS FLIGHT SOLID STEM AUGERS COMPILED BY M.N.  
 DATUM Geodetic DATE May 12, 2009 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			UNIT WEIGHT  γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)				
232.1	Ground surface					*		20	40	60	80	100				
0.0	80mm asphalt over sand and gravel, trace silt						232									
231.6	Brown Moist (PAVEMENT FILL)															
0.5	Clayey silt mixed with gravelly sand															
231.0	Grey/brown (FILL)						231									
1.1	Silty clay some sand, trace gravel															
230.1	Mottled Moist Grey/brown															
2.0	End of auger probe Refusal on probable bedrock															
	* Water level not established															

**METRIC**

DATUM Geodetic DATE May 12, 2009 CHECKED BY C.N.

ON\_MOT VER3 06TF055B-TEXAS\_GATE.GPJ ON\_MOT.GDT 7/22/2009 4:33:37 PM

METRIC  
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES UNLESS  
OTHERWISE SHOWN. STATIONS  
IN KILOMETRES + METRES

CONT No 2009-5131  
WP No 5395-08-01

UNGULATE GUARD AT STA. 10+033.5

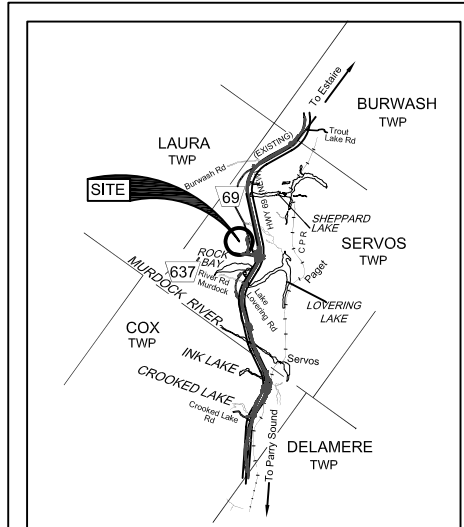
HIGHWAY 637 SERVICE ROAD - SERVOS TWP

BOREHOLE LOCATIONS AND SOIL STRATA



SHEET  
416

**PML Peto MacCallum Ltd.**  
CONSULTING ENGINEERS



KEY PLAN  
SCALE  
0 2 4 6 km

#### LEGEND

- Borehole
- Dynamic Cone Penetration Test (Cone)
- Borehole & Cone
- N Blows/0.3m (Std. Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- \* Water level not established
- W L at time of investigation April & May 2009
- Head
- ARTESIAN WATER Encountered
- PIEZOMETER

BH No	ELEVATION	COORDINATES	
		NORTHINGS	EASTINGS
1	231.9	5 120 822.9	321 989.6
2	231.9	5 120 825.5	321 993.3
3	231.9	5 120 828.0	321 997.0
4	231.4	5 120 816.3	321 994.1
5	231.3	5 120 818.9	321 997.9
6	231.3	5 120 821.4	322 001.6
AP1	232.1	5 120 825.0	321 988.2
AP2	232.1	5 120 827.5	321 991.9
AP3	232.1	5 120 830.1	321 995.6

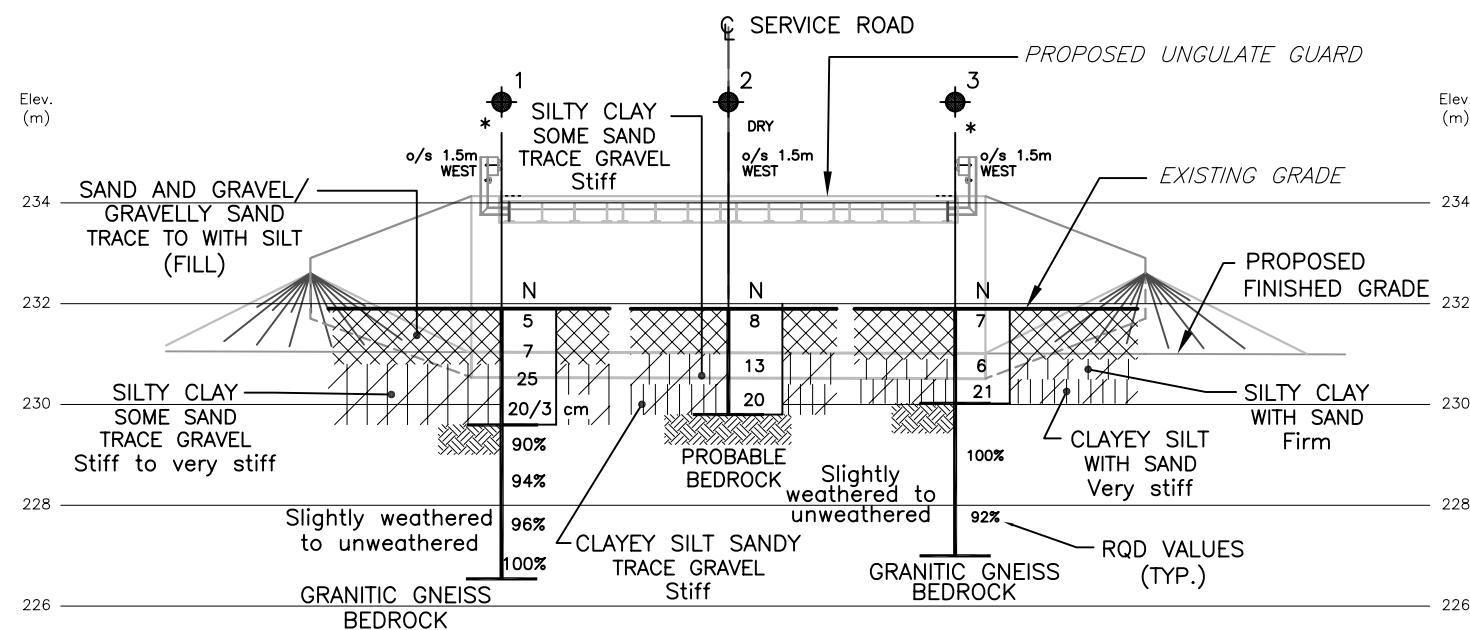
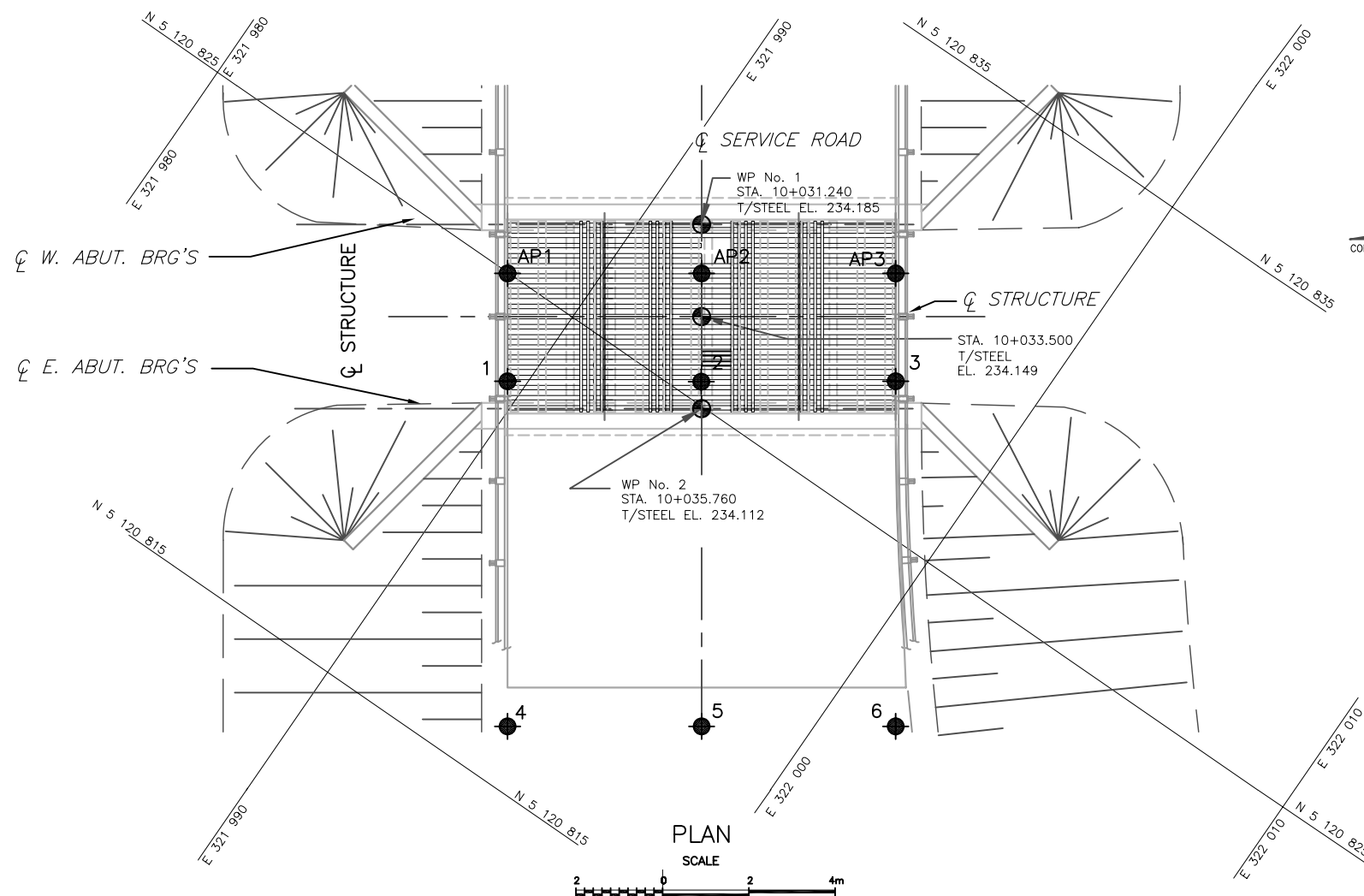
#### NOTE

The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

REVISIONS	DATE	BY	DESCRIPTION

Geocres No. 411-240

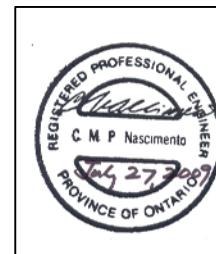
HWY No	69	DIST	54
SUBM'D	MN	CHECKED	CN
DRAWN	NA	CHECKED	CN
DATE	JULY 27, 2009	APPROVED	BRG
SITE	---	DWG	UG-2-1



PROFILE  UNGULATE GUARD AT STA. 10+036

#### NOTES:

- THIS DRAWING IS FOR SUBSURFACE INFORMATION ONLY. SURFACE DETAILS AND FEATURES ARE FOR CONCEPTUAL ILLUSTRATION.
- THE LOCATION OF STRUCTURE WAS MOVED 2.5m NORTHERLY AFTER COMPLETION OF SUBSURFACE INVESTIGATION.



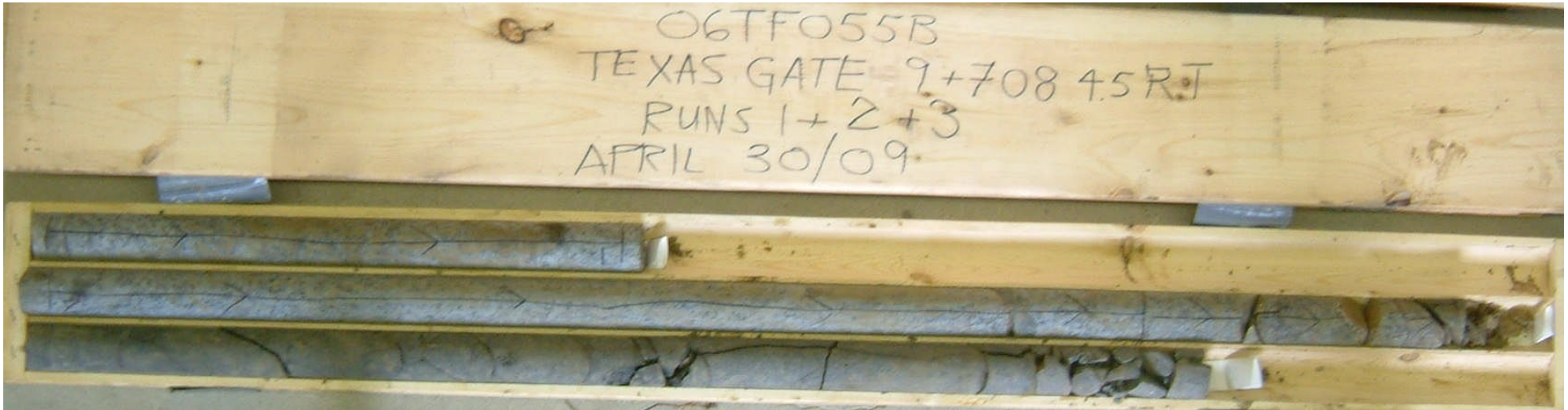
REF No.: TSH DRAWING  
91088-HWY 637 SERVICE RD,-1-S,-UNGULATE GUARD  
-10+036-1-GA.dwg; dated May, 2009.



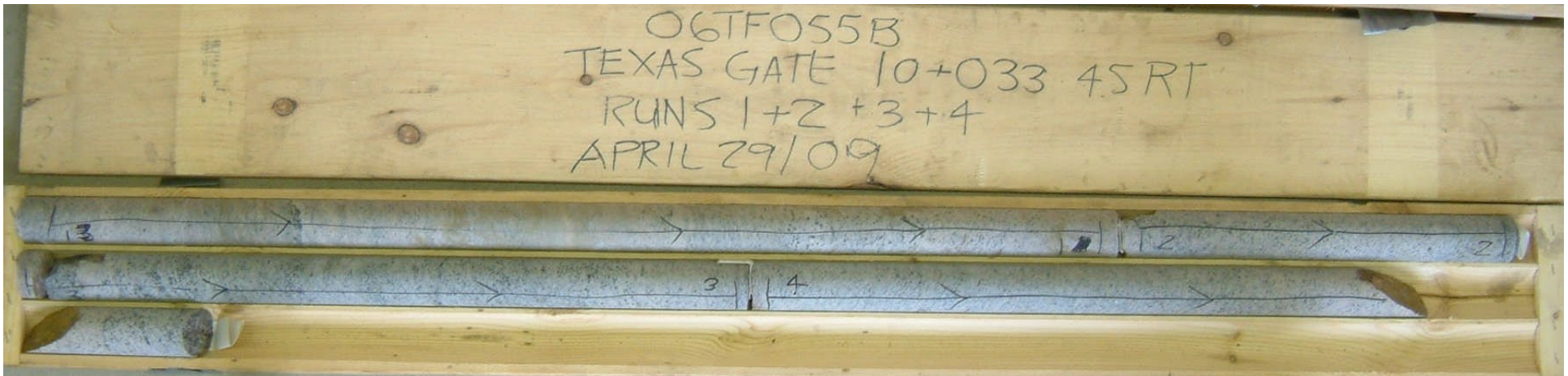
## **APPENDIX A**

### Rock Core Photographs





**Photograph 1:** Ungulate guard at Sta. 9+710, borehole 1, samples RC-9 to RC-11 from 7.2 to 10.5 m depth. The RQD value from 7.2 to 9.3 m depth was 83%, indicating good quality rock. Beyond 9.3 m depth to 10.5 m depth the RQD value was 44%, indicating poor quality rock.

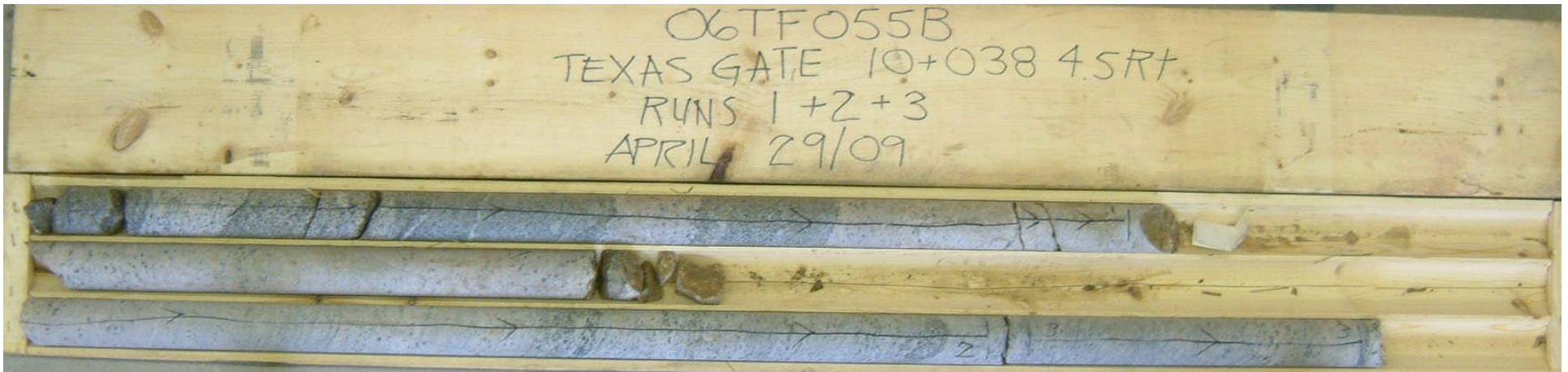


**Photograph 2:** Ungulate guard at Sta. 10+033.5, borehole 1, samples RC-5 to RC-8 from 2.3 to 5.4 m depth. The RQD values ranged from 90 to 100%, indicating excellent quality rock.

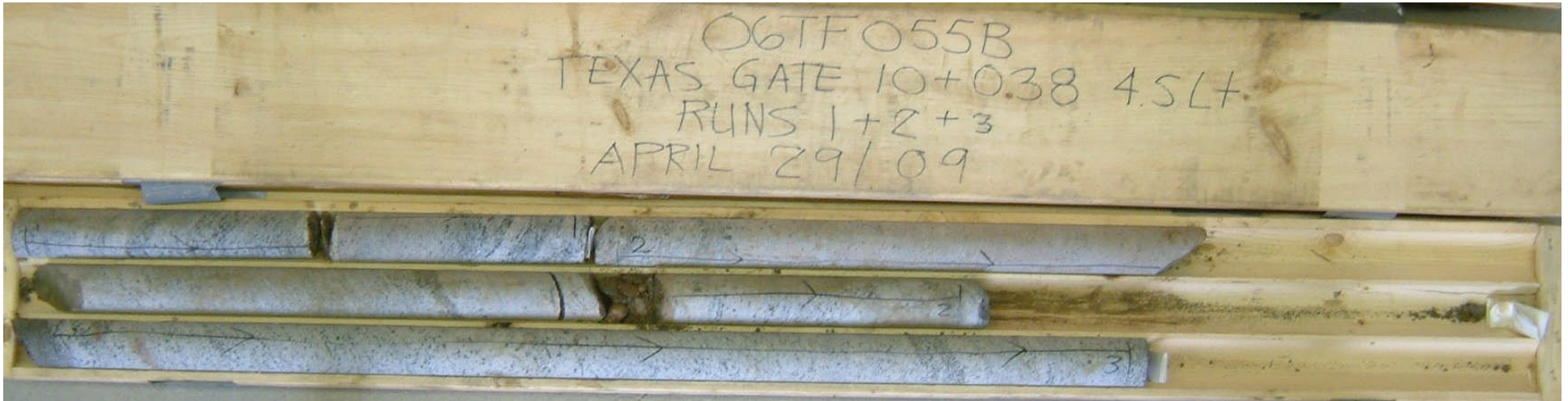




**Photograph 3:** Ungulate guard at Sta. 10+033.5, borehole 3, samples RC-4 and RC-5 from 1.9 to 4.9 m depth. The RQD values ranged from 92 to 100%, indicating excellent quality rock.



**Photograph 4:** Ungulate guard at Sta. 10+033.5, borehole 4, samples RC-4 to RC-6 from 1.8 to 4.8 m depth. The RQD values ranged from 73 to 100%, indicating good to excellent quality rock.



**Photograph 5:** Ungulate guard at Sta. 10+033.5, borehole 6, samples RC-3 to RC-5 from 1.4 to 4.6 m depth. The RQD values ranged from 92 to 100%, indicating excellent quality rock.